

ASTRONOMY

Physical Science

Cosmology = the study of how the universe began, evolve and what it's made of

- BIG BANG THEORY-

Everything started with a big bang or explosion and has been expanding ever since

A rapid expansion of space itself

13.7 billion years ago, using the map of the oldest light in the universe

BIG BANG THEORY - EVIDENCE

- **FUSION** of small elements into larger of ones
 $[H+H \rightarrow He]$

- Cosmic background **radiation**

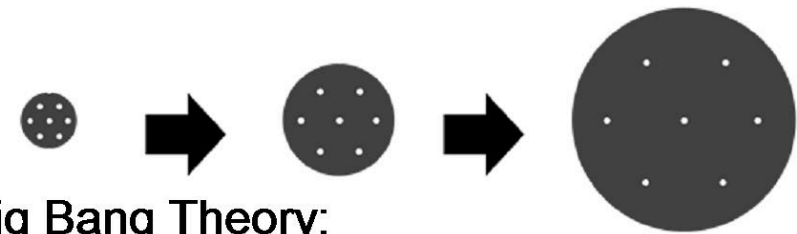
- **Red shift** versus blue shift

Steady – State Theory

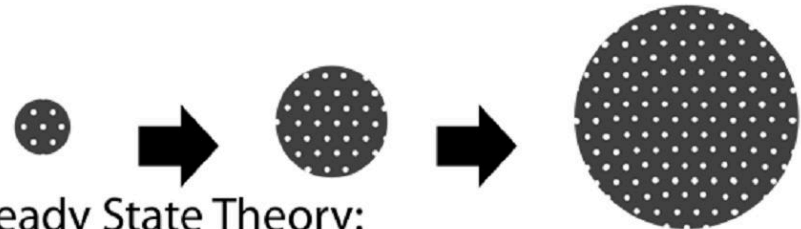
- The universe always has been **expanding**

- As the universe expands new matter is created

- The **density** of the universe remains the same

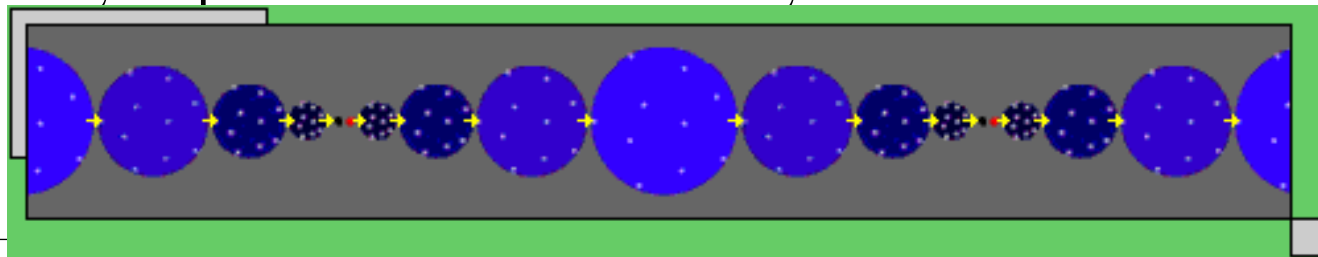


Big Bang Theory:
Density of matter decreases over time



Steady State Theory:
Density of matter is constant over time

- The **oscillating model** the universe will rapidly expand and then slowly expand and then eventually contract



Galaxy

- Large groups of stars, has and dust held together by gravity.
- 40 billion galaxies can be seen
- Galaxies form from the gathering of ancient matter left over from the big band
- Most agree that the center of a galaxy is an extremely massive black hole



The Milky Way Galaxy

- Our galaxy – THE MILKY WAY – contains **400 billion stars**
- Our sun orbits the center of the Milky Way in around 225 million years at a rates of 220 km/s
- **22** orbits have been made
- **Milky way** galaxy is 100,000 light years across
- Our sun lies 26,000 light years away from the galaxies center
- The Milky Way disk is 1,000 light years thick
- Remember the speed of light is 3×10^8 m/s and a light year is the distance that light can travel in one earth year

3 Types of galaxies

- **(blurred) Spiral galaxy:** spiral arms that wind outward from the galaxies center



3 Types of galaxies

- **Elliptical galaxy:** shaped like a large 3-D ellipses. It is football or spherical shaped



The Sombrero Galaxy — M104  HUBBLESITE.org

3 Types of galaxies

- **Irregular galaxies**: not elliptical or spiral.
- Larger than dwarf ellipses but smaller than spiral



Star formation

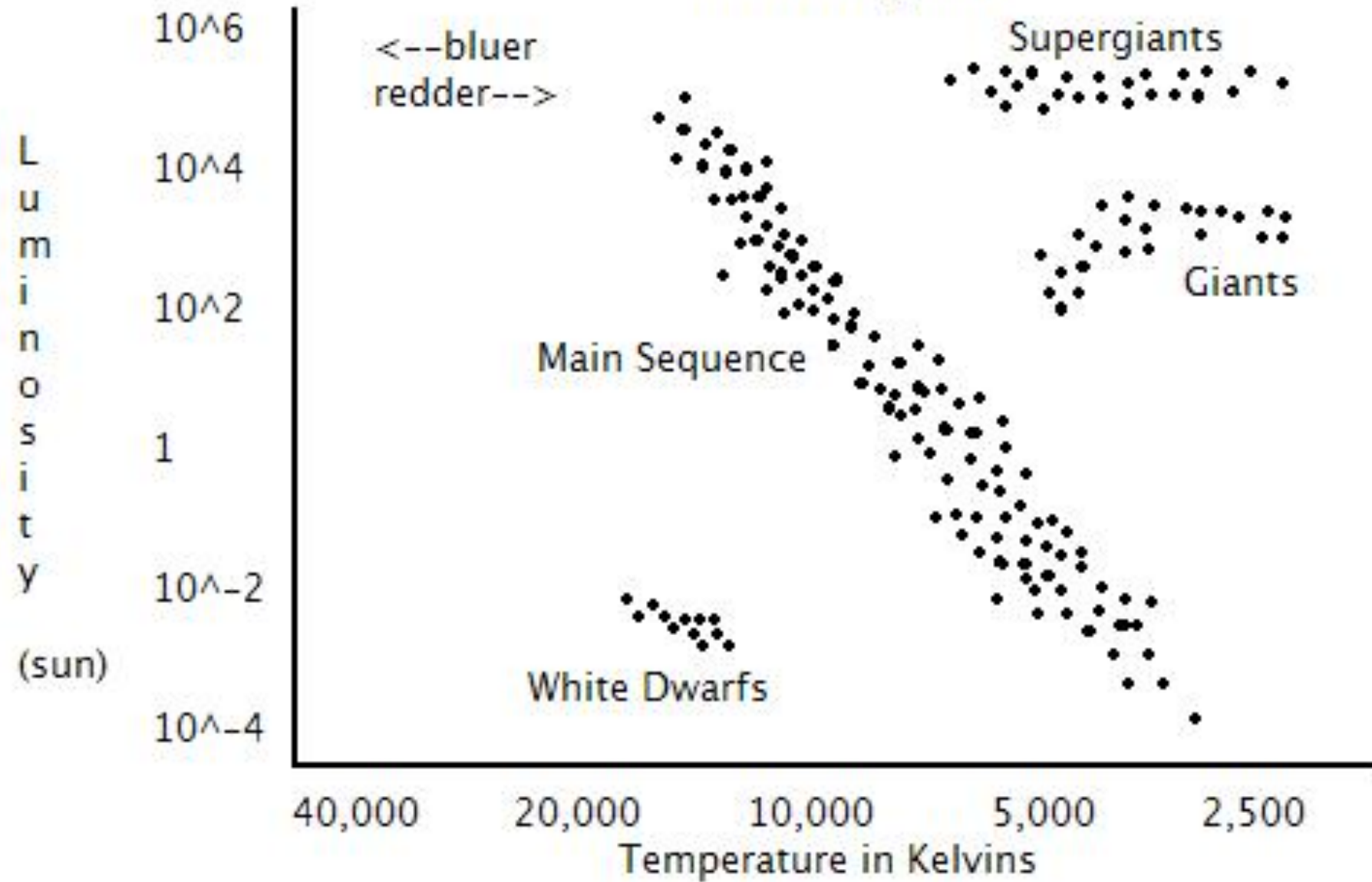
- Begin with the condensing of a large cloud made up of gas, ice and dust called a **nebula**
- These particles exert **gravitational force** on each other and **condensation** of particles causes an increase in temperature
- At 1 million Kelvins, the center of the cloud is called a **protostar**
- At 10 million Kelvins, the Hydrogen begins to fuse forming Helium and the star is born

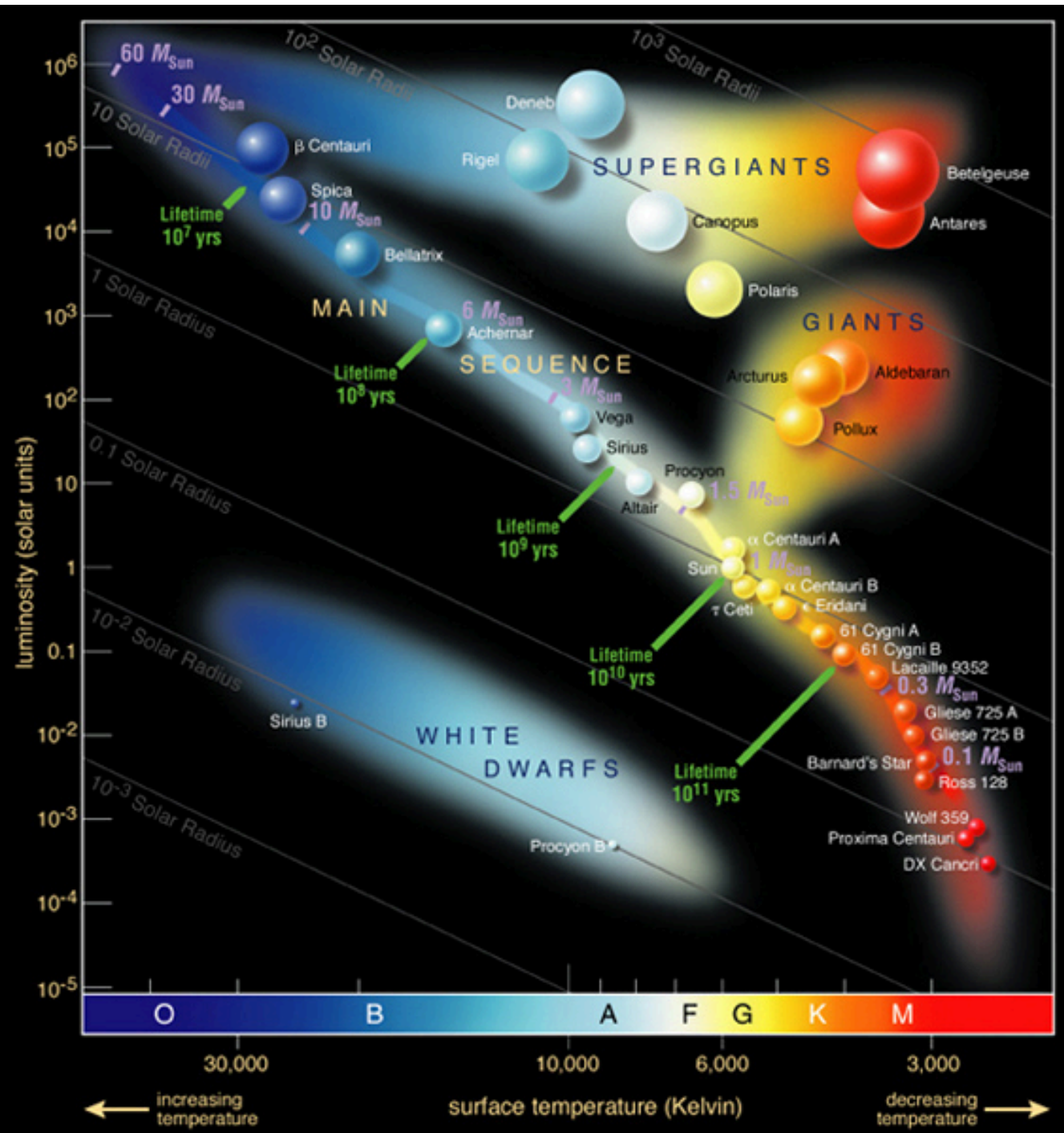


H-R diagram

- Developed in the early 1900's
- Hertzsprung and Russell studied the relationship between **luminosity** and **temperature** of a star
- The higher the temperature the more energy that is being given off resulting in high luminosity
- luminosity (energy emitted per unit time – measured in joules per second aka watts)
- 90% of all stars in **Main Sequence**


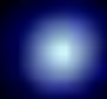








H-R Diagram





Next – determine mass of star

- Average star (our sun) to Giant to white dwarf to black dwarf
- More massive star - supergiant to neutron star to black holes

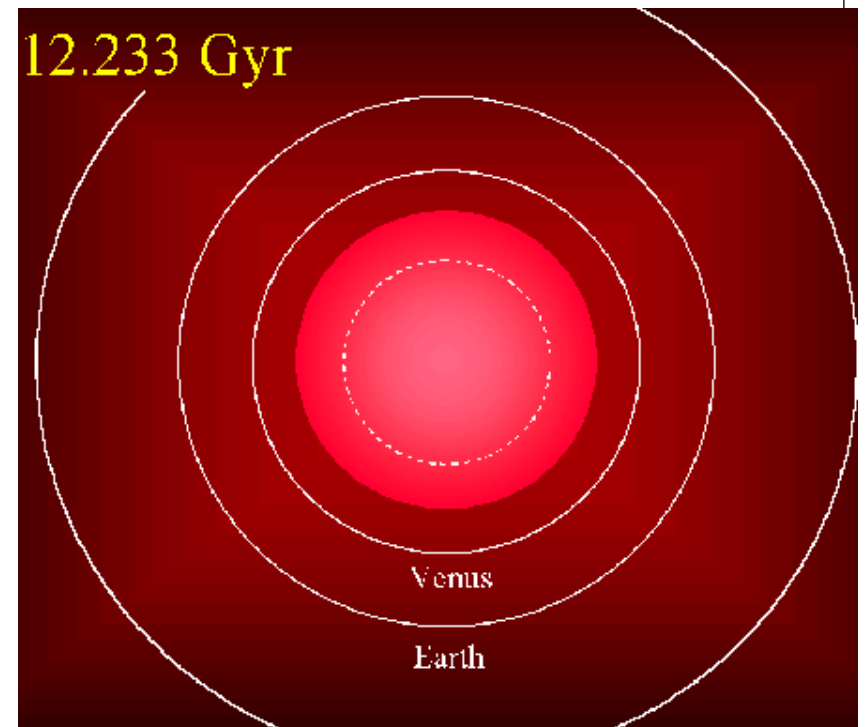
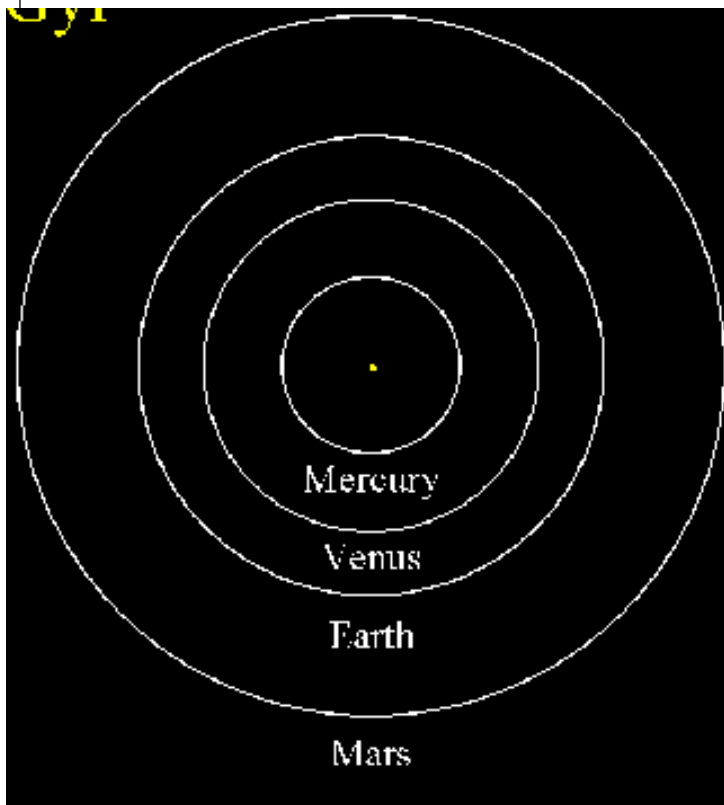
Protostar	Fusion Ignition - Main Sequence		Red Giant/Supergiant	White Dwarf/Black Hole
				
Fetus	Infancy through Adulthood		Middle Age	Old Age-Death
				

Red giant

- When H fuel is used up – outward pressure is overcome by gravity causing the core to contract and the temperature to increase
- Outer layers expand and cool - - we have the fusion of hydrogen to form helium

Now – the sun
has a hot core
and warm
surface it is small
in size

In the future it
will have a very
hot core and a
cool surface if
it will be larger,
less massive and
very bright

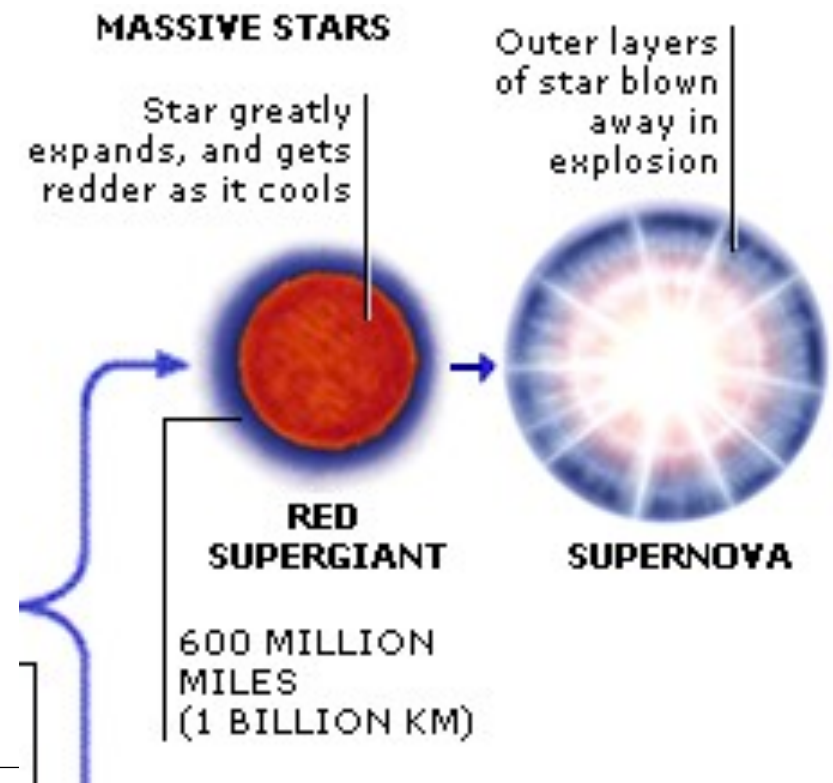


White dwarf

- The red giants core contracts and becomes hotter
- The helium is used up and the star contracts more
- **Helium** fuses to form carbon
- Now the star is large and has a cool surface
- The outer layer escapes into space leaving behind a hot dense core that continues to condense/contract
- The star is now the size of **earth**

More massive - supergiant

- Much more **massive** than our sun
- Core temperature is hot enough to cause fusion that produces larger elements than helium
- Star expands
- Eventually **iron** forms in the core which no longer fuses
- No outward radiation of energy to counteract gravity – core collapses violently and outer portion of the star explodes
- This produces a **supernova**

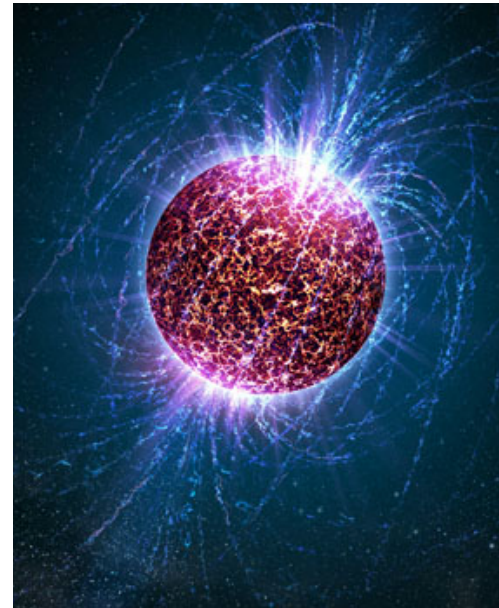


Supernova

- Gigantic explosion where temperatures reach over 10 billion Kelvin and atomic nuclei are split into neutrons and protons
- Type 1 supernova (our suns future) form from hydrogen poor, low mass stars that pull in matter from a nearby red giant
- Type 2 supernova (more massive stars) form from hydrogen rich, high mass stars, leave a collapsed core that can then condense into a **neutron star** or a **black hole**

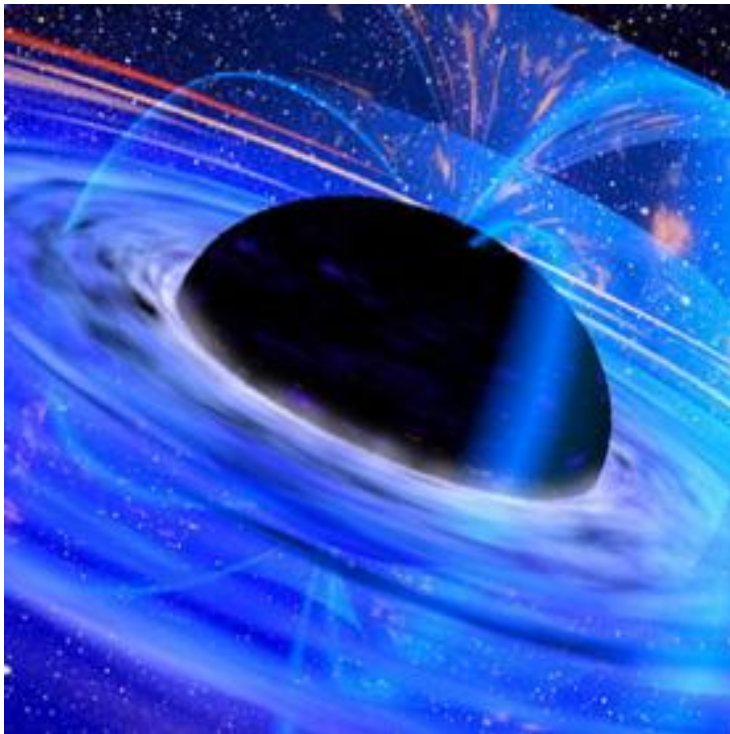
Neutron star

- Protons merge with electrons to form **neutrons** and the collapsing core becomes a neutron star
- gravity on a neutron star is 2 billion times stronger than gravity on Earth



Black hole

- Very massive (25x our sun) – core collapse pas neutron stage forming an object so dense that **nothing** can escape its gravity



Only objects closer to the black hole than a certain point are sucked in

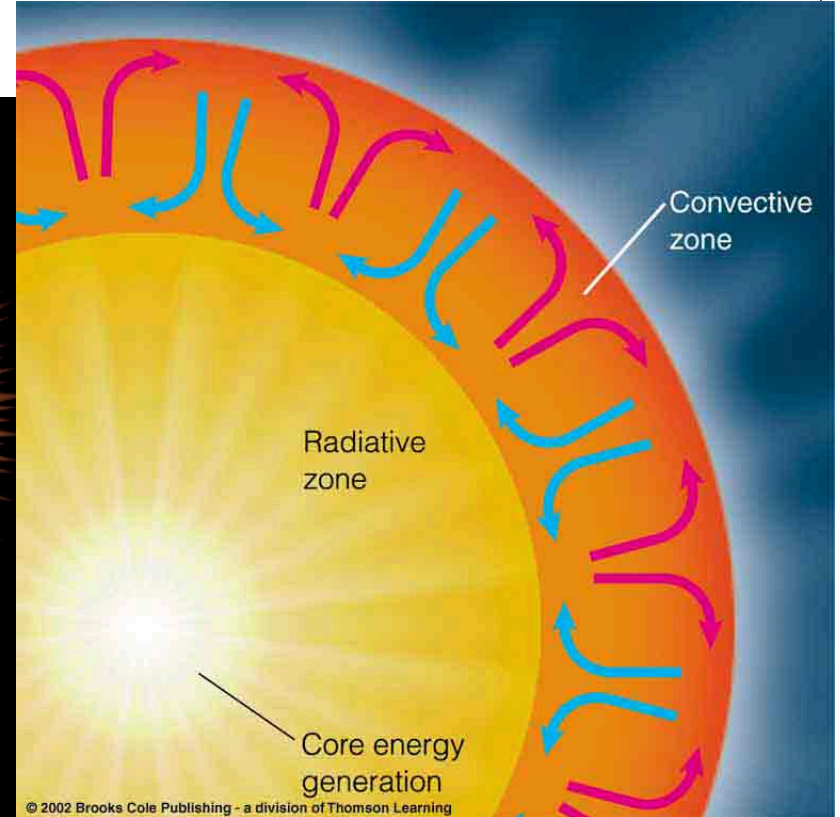
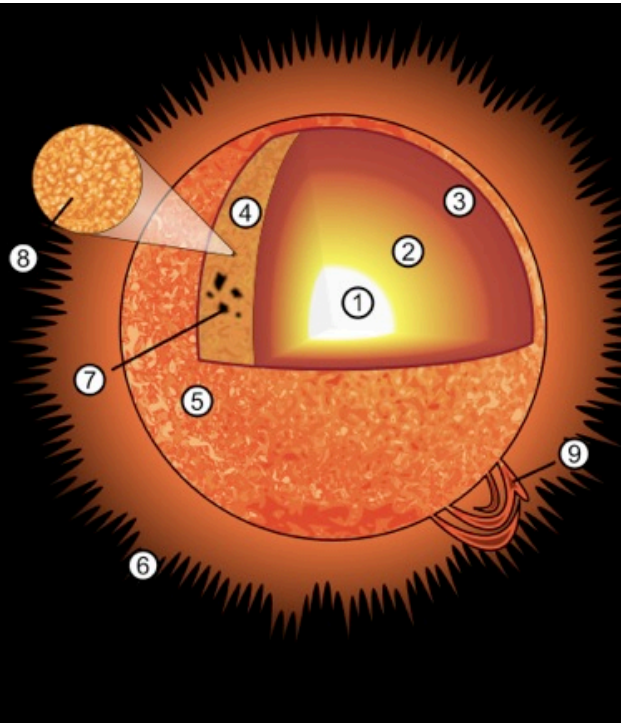
This point is called the **event horizon**

The
sun's
interior

- The sun's interior is composed of the core, radiation zone and the convection zone
- Core is the inner most layer where FUSION occurs
- Radiation zone energy transfers through this zone
- Convection zone hotter gases rise due to lower density

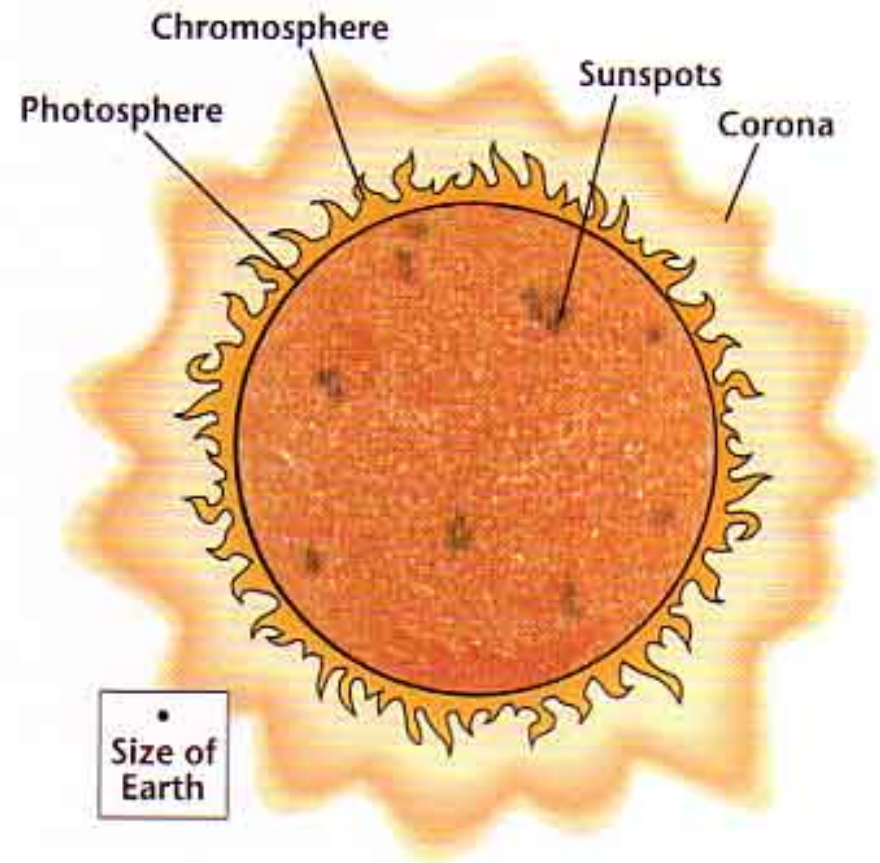
Cooler gases sink

- 1) Core
- 2) Radiative zone
- 3) Convective zone
- 4) Photosphere
- 5) Chromosphere
- 6) Corona
- 7) Sunspots
- 8) Granulation
- 9) Prominence



The suns exterior

- The **exterior** is composed of the **photosphere**, the **chromosphere** and the **corona**
- **Photosphere** give us light – the surface
- **Chromosphere** is the atmosphere above the photosphere
- **corona** is the hazy layer – the outermost layer



Sunspots

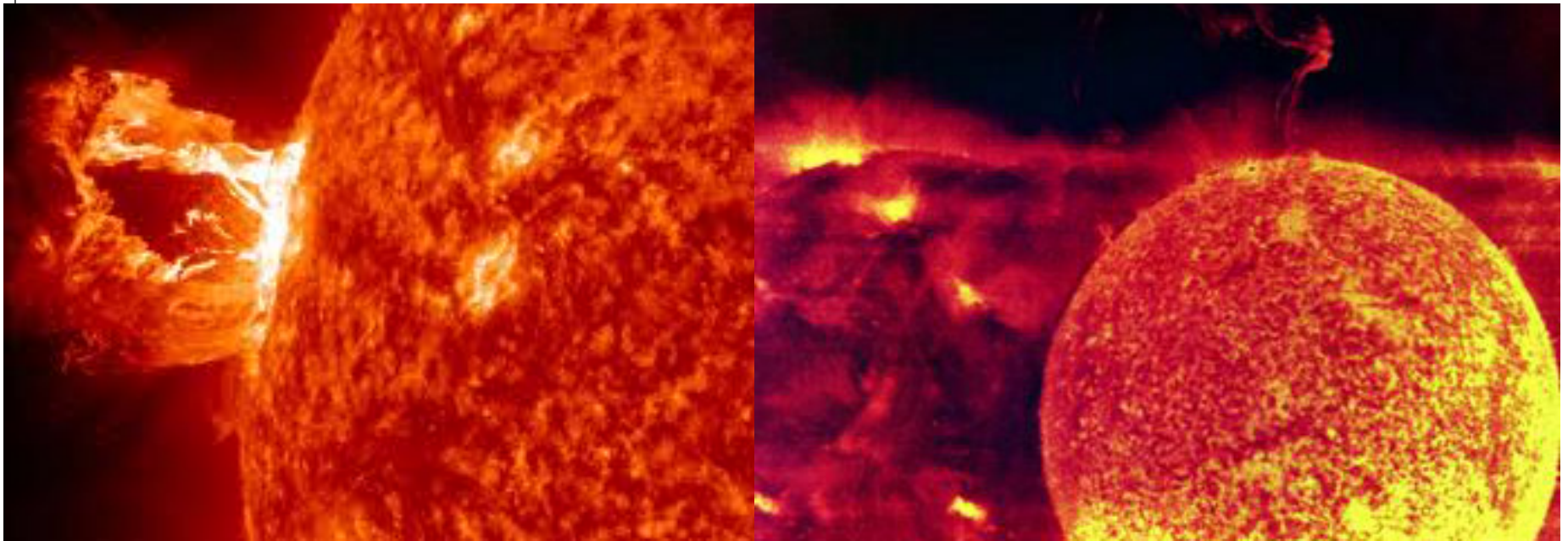
- **Darker** areas on surface are **cooler** than surrounding area



- **Prominences** - Intense magnetic field associated with sunspots causing **arching columns** of gas to erupt
- **Solar flare** – gas near sunspot sometimes brighten suddenly and the gas shoots outward at a high speed

Prominences

Solar flare



Kepler's law

- Just know that planets do not orbit in a circle they orbit in an ellipse

